ANNEX 8
TERMINOLOGY AND ACRONYMS

Below are definitions from FED-STD-1037C, *Glossary of Telecommunication Terms* and from *HF Communications—Science and Technology* by J. M. Goodman (1992, Van Nostrand), and from *Communications Standard Dictionary,* 2nd ed., by M. Weik (1989, Van Nostrand), reprinted (with permission) for handy reference here. The full text of the Federal Standard glossary—with its definitions from the international treaty documents of the *NTIA Manual of Regulations and Procedures for Federal Radio Frequency Management* and the ITU *Radio Regulations*—is available at the Web address of http://glossary.its.bldrdoc.gov/fs-1037

ACK: *Abbreviation for* **acknowledge character.**

acknowledge character (ACK): A transmission control character transmitted by the receiving station as an affirmative response to the sending station. *Note:* An acknowledge character may also be used as an accuracy control character.

acknowledgement: 1. A response sent by a receiver to indicate successful receipt of a transmission. An example of an acknowledgement is a protocol data unit, or element thereof, between peer entities, to indicate the status of data units that have been successfully received. **2.** A message from the addressee informing the originator that the originator's communication has been received and understood.

adaptive: The process associated with automatically altering operating parameters and/or system configuration in response to changes in time-varying channel propagation conditions and external noise.

adaptive routing: The process of routing calls based on network conditions. The routing decision may come from the sender, may be dynamic with each node making routing decisions, or may be based on instructions issued by a centralized point such as a network control station (NCS). The sender may not have up-to-date information, so this node may not be able to direct traffic for maximum efficiency. In some cases, a centralized scheme may be desirable, but the central node may not have the latest information. The individual node in the process of relaying will likely have the best information for at least one hop. However, unless information is distributed or relayed throughout the system, this node may not be able to see beyond a single hop with any degree of efficiency.

additive white gaussian noise (AWGN): *Synonym* **white noise.**

ALE: *Abbreviation for* **automatic link establishment. 1.** In high-frequency (HF) radio, the capability of a station to make contact, or initiate a circuit, between itself and another specified radio station, without human intervention and usually under processor control. ALE techniques include automatic signaling, selective calling, and automatic handshaking. Other automatic techniques that are related to ALE are channel scanning and selection, link quality analysis (LQA), polling, sounding, message store-and-forward, address protection, and anti-spoofing. **2.** In HF radio, a link control system that includes automatic scanning, selective calling, sounding, and transmit

channel selection using link quality analysis data. Optional ALE functions include polling and the exchange of orderwire commands and messages.

allcall: In adaptive high-frequency (HF) radio automatic link establishment (ALE), a general broadcast that does not request responses and does not designate any specific addresses. This essential function is required for emergencies ("HELP"), sounding-type data exchanges, and propagation and connectivity tracking.

availability: 1. The degree to which a system, subsystem, or equipment is operable and in a committable state at the start of a mission, when the mission is called for at an unknown, *i.e.*, a random, time. The conditions determining operability and committability must be specified. Expressed mathematically, availability is 1 minus the unavailability. **2.** The ratio of (a) the total time a functional unit is capable of being used during a given interval to (b) the length of the interval. An example of availability is 100/168 if the unit is capable of being used for 100 hours a week. Typical availability objectives are specified in decimal fractions, such a 0.9998.

backscattering: 1. Radio wave propagation in which the direction of the incident and scattered waves, resolved along a reference direction (usually horizontal) are oppositely directed. A signal received by backscattering is often referred to as "backscatter." **2.** In optics, the scattering of light into a direction generally opposite to the original one.

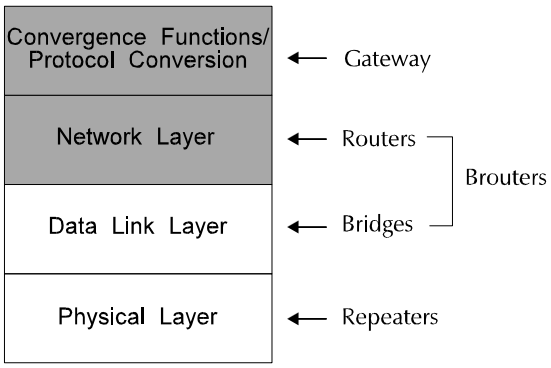
basic mode reliability: The mode reliability, denoted by the term R_m, is given by:

$$R_m = P_{SNR}$$

where Q is the mode availability, and PSNR is a conditional probability that the required signal-to-noise ratio (SNR) is exceeded, under the condition that the mode exists. The above equation presumes that mode presence is independent of signal strength.

BER: *Abbreviation for* **bit error ratio**. The number of erroneous bits divided by the total number of bits transmitted, received, or processed over some stipulated period. Examples of bit error ratio are (a) transmission BER, *i.e.*, the number of erroneous bits received divided by the total number of bits transmitted; and (b) information BER, *i.e.*, the number of erroneous decoded (corrected) bits divided by the total number of decoded (corrected) bits. The BER is usually expressed as a coefficient and a power of 10; for example, 2.5 erroneous bits out of 100,000 bits transmitted would be 2.5 out of 10^5 or 2.5×10^{-5}.

bridge: 1. In communications networks, a device that (a) links or routes signals from one ring or bus to another or from one network to another, (b) may extend the distance span and capacity of a single LAN system, (c) performs no modification to packets or messages, (d) operates at the data-link layer of the OSI—Reference Model (Layer 2), (e) reads packets, and (f) passes only those with addresses on the same segment of the network as the originating user. **2.** A functional unit that interconnects two local area networks that use the same logical link control procedure, but may use different medium access control procedures. **3.** A balanced electrical network, *e.g.*, a Wheatstone bridge. A bridge may be used for electrical measurements, especially resistances or impedances. **4.** *See* **hybrid coil.**



Association of OSI Ref-Model layers with bridges, gateways, *etc.*

broadband: *Synonym* **wideband.**

broadcast operation: The transmission of signals that may be simultaneously received by stations that usually make no acknowledgement.

brouter: A combined bridge and router that operates without protocol restrictions, routes data using a protocol it supports, and bridges data it cannot route.

buffer: **1.** A routine or storage medium used to compensate for a difference in rate of flow of data, or time of occurrence of events, when transferring data from one device to another. Buffers are used for many purposes, such as (a) interconnecting two digital circuits operating at different rates, (b) holding data for use at a later time, (c) allowing timing corrections to be made on a data stream, (d) collecting binary data bits into groups that can then be operated on as a unit, (e) delaying the transit time of a signal in order to allow other operations to occur. **2.** To use a buffer or buffers. **3.** An isolating circuit, often an amplifier, used to minimize the influence of a driven circuit on the driving circuit. *Synonym* **buffer amplifier**. **4.** In a fiber optic communication cable, one type of component used to encapsulate one or more optical fibers for the purpose of providing such functions as mechanical isolation, protection from physical damage and fiber identification. *Note:* The buffer may take the form of a miniature conduit, contained within the cable and called a loose buffer, or loose buffer tube, in which one or more fibers may be enclosed, often with a lubricating gel. A tight buffer consists of a polymer coating in intimate contact with the primary coating applied to the fiber during manufacture.

busy hour: In a communications system, the sliding 60-minute period during which occurs the maximum total traffic load in a given 24-hour period. *Note 1:* The busy hour is determined by fitting a horizontal line segment equivalent to one hour under the traffic load curve about the peak load point. *Note 2:* If the service time interval is less than 60 minutes, the busy hour is the 60-minute interval that contains the service timer interval. *Note 3:* In cases where more than one busy hour occurs in a 24-hour period, *i.e.*, when saturation occurs, the busy hour or hours most applicable to the particular situation are used. *Synonym* **peak busy hour.**

call intensity: *Synonym* **traffic intensity.**

channel frequency scanning: *See* **scanning.**

channel occupancy: The fraction of measurement time in which the interference level exceeds a defined threshold. *[From Goodman, 1992, used with written permission.]*

chirpsounding: linear sweep sounding or linear FM modulation that consists of sendin a low-power 2-to-30-MHz linear FM/cw test signal over the communication path. This method can be used over eith a vertical or an oblique path. The data received from the chirpsounding equipment is similar to the pulse sounding equipment, but has the advantage of causing less interference to nearby equipment.

circuit reliability: **1.** The probability that for a given circuit and single frequency, a specified performance is achieved. **2.** The percentage of time a circuit was available for use in a specified period of scheduled availability. *Note 1:* Circuit reliability is given by

$$CiR = 100\,[1 - T_o/T_s] = 100\,(T_a/T_s)$$

where T_o is the circuit total outage time, T_s is the circuit total scheduled time, and T_a is the circuit total available time.
Note 2: $T_s = T_a + T_o$. *Synonym* **time availability.**

class of emission: The set of characteristics of an emission, designated by standard symbols, *e.g.* , type of modulation of the main carrier, modulating signal, type of information to be transmitted, and also, if appropriate, any additional signal characteristics. [NTIA] [RR]

class of service: 1. A designation assigned to describe the service treatment and privileges given to a particular terminal. **2.** A subgrouping of telephone users for the purpose of rate distinction. Note: Examples of class of service subgrouping include distinguishing between (a) individual and party lines, (b) Government and non-Government lines, (c) those permitted to make unrestricted international dialed calls and those not so permitted, (d) business, residence, and coin-operated, (e) flat rate and message rate, and (f) restricted and extended area service. **3.** A category of data transmission provided by a public data network in which the data signaling rate, the terminal operating mode, and the code structure, are standardized. *Note:* Class of service is defined in CCITT Recommendation X.1. *Synonym* **user service class.**

communications net: An organization of stations capable of direct communication on a common channel or frequency. *Synonym* **net**.

congestion: 1. In a communications switch, a state or condition that occurs when more subscribers attempt simultaneously to access the switch than it is able to handle, even if unsaturated. **2**. In a saturated communications system, the condition that occurs when an additional demand for service occurs. [from 1037C] **4.** The probability of randomly finding within each 50-kHz spectrum a 100-Hz frequency interval in which the average interference level exceeds a defined threshold. *[from Goodman, 1992, used with permission]*

cutover: The physical changing of circuits or lines from one configuration to another.

data rate: *See* **data signaling rate.**

data signaling rate (DSR): The aggregate rate at which data pass a point in the transmission path of a data transmission system. *Note 1:* The DSR is usually expressed in bits per second. *Note 2:* The data signaling rate is given by

$$\sum_{i=1}^{m} \frac{\log_2 n_i}{T_i},$$

where m is the number of parallel channels, ni is the number of significant conditions of the modulation in the I-th channel, and Ti is the unit interval, expressed in seconds, for the I-th channel. *Note 3*: For serial transmission in a single channel, the DSR reduces to $(1/T)\log_2 n$; with a two-condition modulation, *i.e.* , n =2, the DSR is 1/T . *Note 4:* For parallel transmission with equal unit intervals and equal numbers of significant conditions on each channel, the DSR is $(m/T)\log_2 n$; in the case of a two-condition modulation, this reduces to m /T . *Note 5:* The DSR may be expressed in bauds, in which case, the factor $\log_2 n_i$ in the above summation formula should be deleted when calculating bauds. *Note 6:* In synchronous binary signaling, the DSR in bits per second may be numerically the same as the modulation rate expressed in bauds. Signal

processors, such as four-phase modems, cannot change the DSR, but the modulation rate depends on the line modulation scheme, in accordance with Note 4. For example, in a 2400 b/s 4-phase sending modem, the signaling rate is 2400 b/s on the serial input side, but the modulation rate is only 1200 bauds on the 4-phase output side.

delay: 1. The amount of time by which an event is retarded. **2.** The time between the instant at which a given event occurs and the instant at which a related aspect of that event occurs. *Note 1:* The events, relationships, and aspects of the entity being delayed must be precisely specified. *Note 2:* Total delay may be demonstrated by the impulse response of a device or system. *Note 3:* In analog systems, total delay is described in terms of the transfer functions in the frequency domain. *Synonym* **delay time. 3** . In radar, the electronic delay of the start of the time base used to select a particular segment of the total.

delay time: *Synonym* **delay** (def. #1).

demand assignment: An operation in which several users share access to a communications channel on a real-time basis, i.e. , a user needing to communicate with another user on the same network requests the required circuit, uses it, and when the call is finished, the circuit is released, making the circuit available to other users. *Note*: Demand assignment is similar to conventional telephone switching, in which common trunks are provided for many users, on a demand basis, through a limited-size trunk group.

disengagement attempt: An attempt to terminate a telecommunications system access. *Note*: Disengagement attempts may be initiated by a user or the telecommunications system.

disengagement denial: After a disengagement attempt, a failure to terminate the telecommunications system access. *Note*: Disengagement denial is usually caused by excessive delay in the telecommunications system.

disengagement failure: Failure of a disengagement attempt to return a communication system to the idle state, for a given user, within a specified maximum disengagement time.

e-mail (electronic mail): An electronic means for communication in which (a) usually text is transmitted, (b) operations include sending, storing, processing, and receiving information, (c) users are allowed to communicate under specified conditions, and (d) messages are held in storage until called for by the addressee.

e-mail reflector: *Synonym* **reflector.**

equalization: The maintenance of system transfer function characteristics within specified limits by modifying circuit parameters. Equalization includes modification of circuit parameters, such as resistance, inductance, or capacitance.

erlang: A dimensionless unit of the average traffic intensity (occupancy) of a facility during a period of time, usually a busy hour. *Note 1:* Erlangs, a number between 0 and 1, inclusive, is expressed as the ratio of (a) the time during which a facility is continuously or cumulatively occupied to (b) the time that the facility is available for occupancy. *Note 2:* Communications traffic, measured in erlangs for a period of time, and offered to a group of shared facilities, such as a trunk group, is equal to the average of the traffic intensity, in erlangs for the same period of time, of all individual sources, such as telephones, that share and are served exclusively by this group of facilities. *Synonym* **traffic unit.**

exempted addressee: An organization, activity, or person included in the collective address group of a message and deemed by the message originator as having no need for the information in the message. *Note*: Exempted addressees may be explicitly excluded from the collective address group for the particular message to which the exemption applies.

exploder: *Synonyms* **e-mail mailing list; reflector, server.**

flood search routing: In a telephone network, nondeterministic routing in which a dialed number received at a switch is transmitted to all switches, *i.e.,* flooded, in the area code directly connected to that switch; if the dialed number is not an affiliated subscriber at that switch, the number is then retransmitted to all directly connected switches, and then routed through the switch that has the dialed number corresponding to the particular user end instrument affiliated with it. *Note 1:* All digits of the numbering plan are used to identify a particular subscriber. *Note 2:* Flood search routing allows subscribers to have telephone numbers independent of switch codes. *Note 3:* Flood search routing provides the highest probability that a call will go through even though a number of switches and links fail.

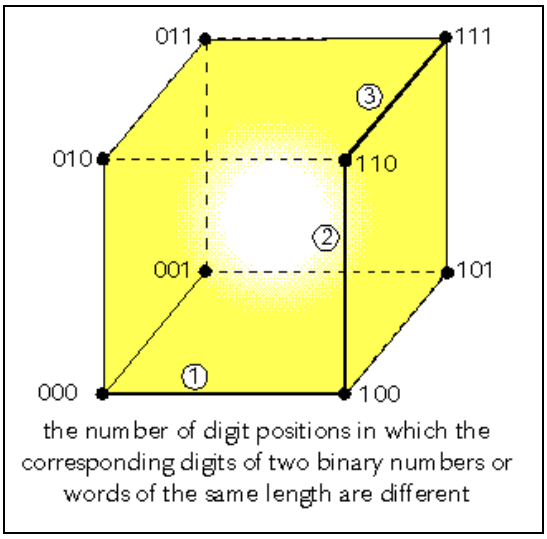
flow control: *See* **transmit flow control.**

FOT: *Abbreviation for* **frequency of optimum travail.** In transmission of radio waves via ionospheric reflection, the highest effective, *i.e.,* working frequency that is predicted to be usable for a specified path and time for 90% of the days of the month. The FOT is normally just below the value of the maximum usable frequency 9MUF). In the prediction of usable frequencies, the FOT is commonly taken as 15% below the monthly median value of the MUF for the specified time and path. The FOT is usually the most effective frequency for ionospheric reflection of radio waves between two specified points on Earth. *Synonyms* frequency of optimum traffic, optimum traffic frequency, optimum transmission frequency, optimum working frequency.

Fourier analysis: The definition of a periodic waveform of arbitrary shape as a summation of sine waves having specific amplitudes and phases, and having frequencies corresponding to the harmonics of the waveform being defined. A Fourier analysis is particularly well suited for communications equipment design and for predicting the performance of a given design.

gateway: 1. In a communications network, a network node equipped for interfacing with another network that uses different protocols. *Note 1:* A gateway may contain devices such as protocol translators, impedance matching devices, rate converters, fault isolators, or signal translators as necessary to provide system interoperability. It also requires that mutually acceptable administrative procedures be established between the two networks. *Note 2:* A protocol translation/mapping gateway interconnects networks with different network protocol technologies by performing the required protocol conversions. **2.** *Loosely*, a computer configured to perform the tasks of a gateway.

Hamming distance: The number of digit positions in which the corresponding digits of two binary words of the same length are different. The Hamming distance between 1011101 and 1001001 is two. The concept can be extended to other notation systems. For example, the Hamming distance between 2143896 and 2233796 is three, and between "toned" and "roses" it is also three. *Synonym* **signal distance**.

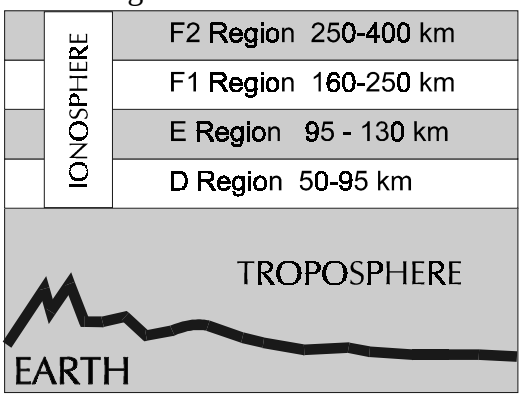


Hamming distance

HF: *Abbreviation for* **high frequency.** Frequencies from 3 MHz to 30 MHz.

hierarchical routing: Routing that is based on hierarchical addressing. *Note:* Most Transmission Control Protocol/Internet Protocol (TCP/IP) routing is based on a two-level hierarchical routing in which an IP address is divided into a network portion and a host portion. Gateways use only the network portion until an IP datagram reaches a gateway that can deliver it directly. Additional levels of hierarchical routing are introduced by the addition of subnetworks.

ionosphere: That part of the atmosphere, extending from about 70 to 500 km, in which ions and free electrons exist in sufficient quantities to reflect and/or refract electromagnetic waves.



ionosphere sounder: A device that transmits signals for the purpose of determining ionospheric conditions. [NTIA] [Radio Regulations—RR]

ionospheric pulse sounding: *See* **ionospheric sounding, sounding.**

ionospheric reflection: Of electromagnetic waves propagating in the ionosphere, a redirection, *i.e.*, bending—by a complex processing involving reflection and refraction—of the waves back toward the Earth. The amount of bending depends on the extent of penetration (which is a function of frequency), the angle of incidence, polarization of the wave, and ionospheric conditions, such as the ionization density.

ionospheric scatter: The propagation of radio waves by scattering as a result of irregularities or discontinuities in the ionization of the ionosphere. [NTIA] [RR]

ionospheric sounding: A technique that provides real-time data on high-frequency ionospheric-dependent radio propagation, using a basic system consisting of a synchronized transmitter and receiver. The time delay between transmission and reception is translated into effective ionospheric layer altitude. Vertical incident sounding uses a collocated transmitter and receiver and involves directing a range of frequencies vertically to the ionosphere and measuring the values of the reflected returned signals to determine the effective ionosphere layer altitude. This technique is also used to determine the critical frequency. Oblique sounders use a transmitter at one end of a given propagation path, and a synchronized receiver, usually with an oscilloscope-type display (ionogram), at the other end. The transmitter emits a stepped- or swept-frequency signal, which is displayed or measured at the receiver. The measurement converts time delay to effective altitude of the ionospheric layer.

The ionogram display shows the effective altitude of the ionospheric layer as a function of frequency.

ionospheric turbulence: Ongoing disturbances of the ionosphere that scatter incident electromagnetic waves. Ionospheric turbulence results in irregularities in the composition of the ionosphere that change with time. This causes changes in reflection properties. These, in turn, cause changes in skip distance, fading, local intensification, and distortion of the incident waves.

intersymbol interference: **1.** In a digital transmission system, distortion of the received signal, which distortion is manifested in the temporal spreading and consequent overlap of individual pulses to the degree that the receiver cannot reliably distinguish between changes of state, *i.e.* , between individual signal elements. At a certain threshold, intersymbol interference will compromise the integrity of the received data. Intersymbol interference attributable to the statistical nature of quantum mechanisms sets the fundamental limit to receiver sensitivity. Intersymbol interference may be measured by eye patterns. **2.** Extraneous energy from the signal in one or more keying intervals that interferes with the reception of the signal in another keying interval. **3.** The disturbance caused by extraneous energy from the signal in one or more keying intervals that interferes with the reception of the signal in another keying interval.

linear sweep sounding: *See* **chirpsounding.**

link: **1.** The communications facilities between adjacent nodes of a network. **2.** A portion of a circuit connected in tandem with, *i.e.*, in series with, other portions. **3.** A radio path between two points, called a radio link. **4.** In communications, a general term used to indicate the existence of communications facilities between two points. [Joint Pub. 1-02] **5.** A conceptual circuit, *i.e.*, logical circuit, between two users of a network, that enables the users to communicate, even when different physical paths are used. In all cases, the type of link, such as data link, downlink, duplex link, fiber optic link, line-of-sight link, point-to-point link, radio link and satellite link, should be identified. A link may be simplex, half-duplex, or duplex. **6.** In a computer program. . . . **7.** In hypertext, . . .

link orderwire: A voice or data communications circuit that (a) serves as a transmission link between adjacent communications facilities that are interconnected by a transmission link and (b) is used only for coordination and control of link activities, such as traffic monitoring and traffic control.

link protocol: A set of rules relating to data communications over a data link. Link protocols define data link parameters, such as transmission code, transmission mode, control procedures, and recovery procedures.

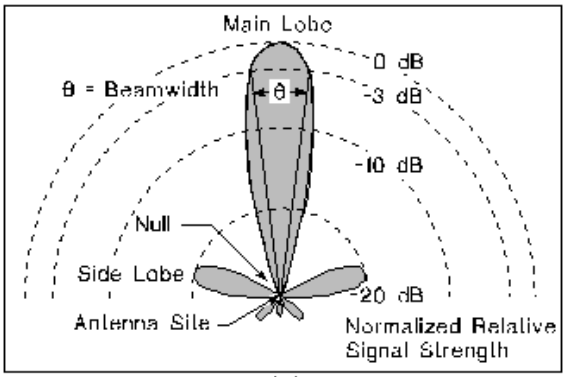
link quality analysis (LQA): In adaptive high-frequency (HF) radio, the overall process by which measurements of signal quality are made, assessed, and analyzed. In LQA, signal quality is determined by measuring, assessing, and analyzing link parameters, such as bit error ratio (BER), and the levels of the ratio of signal-plus-noise-plus-distortion to noise-plus-distortion (SINAD). Measurements are stored at—and exchanged between—stations, for use in making decisions about link establishment. For adaptive HF radio, LQA is automatically performed and is usually based on analyses of pseudo-BERs and SINAD readings.

lowest usable high frequency (LUF): The lowest frequency in the HF band at which the received field intensity is sufficient to provide the required signal-to-noise ratio for a specified time period, *e.g.,* 0100 to 0200 UTC, on 90% of the undisturbed days of the month.

LUF: *Abbreviation for* **lowest usable high frequency.**

main beam: *Synonym* **main lobe.**

main lobe: Of an antenna radiation pattern, the lobe containing the maximum power (exhibiting the greatest field strength). *Note:* The horizontal radiation pattern, *i.e.,* that which is plotted as a function of azimuth about the antenna, is usually specified. The width of the main lobe is usually specified as the angle encompassed between the points where the power has fallen 3 dB below the maximum value. The vertical radiation pattern, *i.e.* , that which is plotted as a function of elevation from a specified azimuth, is also of interest and may be similarly specified. *Synonym* **main beam.**



main lobe

maximum usable frequency: In radio transmission using reflection from the regular ionized layers of the ionosphere, the upper frequency limit that can be used for transmission between two points at a specified time. MUF is a median frequency applicable to 50% of the days of a month, as opposed to 90% cited for the lowest usable high frequency (LUF) and the optimum traffic frequency (FOT).

modem: *Acronym for* **modulator/demodulator. 1.** In general, a device that both modulates and demodulates signals. **2.** In computer communications, a device used for converting digital signals into, and recovering them from, quasi-analog signals suitable for transmission over analog communications channels. Many additional functions may be added to a modem to provide for customer service and control features. *Synonym* **signal conversion equipment. 3.** In FDM carrier systems, a device that converts the voice band to and recovers it from, the first level of frequency translation.

mode availability: The probability that for a single circuit and a single frequency a single mode can propagate by ionospheric refraction alone.

mode performance achievement: The probability that for a single circuit, single frequency, and a single mode (which propagates by ionospheric refraction along) a given performance is achieved.

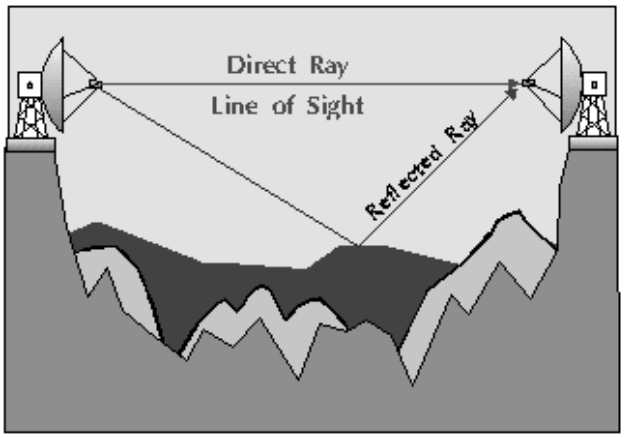
mode reliability: the probability that for a single circuit and a single frequency a specified performance will be achieved by a single mode.

MUF: *Abbreviation for* **maximum usable frequency**.

multiaddress calling: A service feature that permits a user to designate more than one addressee for the same data. *Note*: Multiaddress calling may be performed sequentially or simultaneously.

multipath: The propagation phenomenon that results in radio signals' reaching the receiving antenna by two or more paths. Causes of multipath include atmospheric

ducting, ionospheric reflection and refraction, and reflection from terrestrial objects, such as mountains and buildings. The effects of multipath include constructive and destructive interference, and phase shifting of the signal. In facsimile and television transmission, multipath causes jitter and ghosting.



multipath

multiplex (MUX): *See* **multiplexing.**

multiplexing (MUXing): The combining of two or more information channels onto a common transmission medium. *Note*: In electrical communications, the two basic forms of multiplexing are time-division multiplexing (TDM) and frequency-division multiplexing (FDM). In optical communications, the analog of FDM is referred to as wavelength-division multiplexing (WDM).

NAK: *Acronym for* **negative-acknowledge character.**

NAK attack: In communications security systems, a security penetration technique that makes use of the negative-acknowledge transmission-control character and capitalizes on a potential weakness in a system that handles asynchronous transmission interruption in such a manner that the system is in an unprotected state against unauthorized access during certain periods. [From Weik '89]

narrowband modem: A modem whose modulated output signal has an essential frequency spectrum that is limited to that which can be wholly contained within, and faithfully transmitted through, a voice channel with a nominal 4-kHz bandwidth. High frequency (HF) modems are limited to operation over a voice channel with a nominal 3-kHz bandwidth.

narrowband radio voice frequency (NBRVF): In narrowband radio, the nominal 3-kHz bandwidth allocated for single channel radio that provides a transmission path for analog and quasi-analog signals.

narrowband signal: Any analog signal or analog representation of a digital signal whose essential spectral content is limited to that which can be contained within a voice channel of nominal 4-kHz bandwidth. Narrowband radio uses a voice channel with nominal 3-kHz bandwidth.

negative-acknowledge character (NAK): A transmission control character sent by a station as a negative response to the station with which the connection has been set up. *Note 1:* In binary synchronous communication protocol, the NAK is used to indicate that an error was detected in the previously received block and that the receiver is ready to accept retransmission of that block. *Note 2:* In multipoint systems, the NAK is used as the not-ready reply to a poll.

net: *Synonym* **communications net.**

net control station (NCS): 1. A radio station that performs net control functions, such as controlling traffic and enforcing operational discipline. [From Weik '89] **2.** [A] terminal in a secure telecommunications

net responsible for distributing key in electronic form to the members of the net. [NIS]

net operation: The operation of an organization of stations capable of direct communication on a common channel or frequency. *Note*: Net operations (a) allow participants to conduct ordered conferences among participants who usually have common information needs or related functions to perform, (b) are characterized by adherence to standard formats and procedures, and (c) are responsive to a common supervisory station, called the "net control station," which permits access to the net and maintains net operational discipline.

network: 1. An interconnection of three or more communicating entities. **2.** An interconnection of usually passive electronic components that performs a specific function (which is usually limited in scope), *e.g.*, to simulate a transmission line or to perform a mathematical function such as integration or differentiation. *Note*: A network may be part of a larger circuit.

network administration: A group of network management functions that (a) provide support services, (b) ensure that the network is used efficiently, and (c) ensure prescribed service-quality objectives are met. *Note:* Network administration may include activities such as network address assignment, assignment of routing protocols and routing table configuration, and directory service configuration.

network architecture: 1. The design principles, physical configuration, functional organization, operational procedures, and data formats used as the bases for the design, construction, modification, and operation of a communications network. **2.** The structure of an existing communications network, including the physical configuration, facilities, operational structure, operational procedures, and the data formats in use.

network busy hour (NBH): *See* **busy hour.**

network connectivity: The topological description of a network that specifies, in terms of circuit termination locations and quantities, the interconnection of the transmission nodes.

network engineering: 1. In telephony, the discipline concerned with (a) determining internetworking service requirements for switched networks, and (b) developing and implementing hardware and software to meet them. **2.** In computer science, the discipline of hardware and software engineering to accomplish the design goals of a computer network. **3.** In radio communications, the discipline concerned with developing network topologies.

network interface: 1. The point of interconnection between a user terminal and a private or public network. **2.** The point of interconnection between the public switched network and a privately owned terminal. *Note: Code of Federal Regulations, Title 47, Part 68,* stipulates the interface parameters. **3.** The point of interconnection between one network and another network.

network management: The execution of the set of functions required for controlling, planning, allocating, deploying, coordinating, and monitoring the resources of a telecommunications network, including performing functions such as initial network planning, frequency allocation, predetermined traffic routing to support load balancing, cryptographic key distribution authorization, configuration management, fault management, security management, performance management, and accounting management. *Note:* Network management does not include user terminal equipment.

network manager: In network management, the entity that initiates requests for management information from managed systems or receives spontaneous management-related notifications from managed systems.

network topology: The specific physical, *i.e.*, real, or logical, *i.e*., virtual, arrangement of the elements of a network. *Note 1*: Two networks have the same topology if the connection configuration is the same, although the networks may differ in physical interconnections, distances between nodes, transmission rates, and/or signal types. *Note 2:* The common types of network topology are illustrated [refer to the figure below] and defined in alphabetical order below:

bus topology: A network topology in which all nodes, *i.e.*, stations, are connected together by a single bus.

fully connected topology: A network topology in which there is a direct path (branch) between any two nodes. *Note:* In a fully connected network with n nodes, there are n(n-1)/2 direct paths, *i.e.*, branches. Synonym fully connected mesh network.

hybrid topology: A combination of any two or more network topologies. *Note 1:* Instances can occur where two basic network topologies, when connected together, can still retain the basic network character, and therefore not be a hybrid network. For example, a tree network connected to a tree network is still a tree network. Therefore, a hybrid network accrues only when two basic networks are connected and the resulting network topology fails to meet one of the basic topology definitions. For example, two star networks connected together exhibit hybrid network topologies. *Note 2:* A hybrid topology always accrues when two different basic network topologies are connected.

linear topology: *See* **bus topology.**

mesh topology: A network topology in which there are at least two nodes with two or more paths between them.

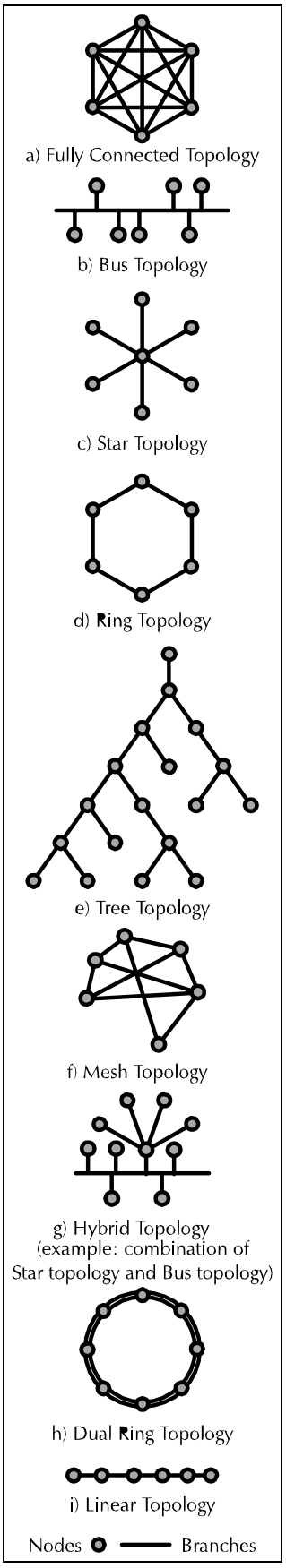
ring topology: A network topology in which every node has exactly two branches connected to it.

star topology: A network topology in which peripheral nodes are connected to a central node, which rebroadcasts all transmissions received from any peripheral node to all peripheral nodes on the network, including the originating node. *Note 1:* All peripheral nodes may thus communicate with all others by transmitting to, and receiving from, the central node only. *Note 2:* The failure of a transmission line, *i.e.*, channel, linking any peripheral node to the central node will result in the isolation of that peripheral node from all others. *Note 3:* If the star central node is passive, the originating node must be able to tolerate the reception of an echo of its own transmission, delayed by the two-way transmission time, *i.e.*, to and from the central node, plus any delay generated in the central node. An active star network has an active central node that usually has the means to prevent echo-related problems.

tree topology: A network topology that, from a purely topologic viewpoint, resembles an interconnection of star networks in that individual peripheral nodes are required to transmit to and receive from one other node only, toward a central node, and are not required to act as repeaters or regenerators. *Note 1:* The function of the central node may be distributed. *Note 2:* As in the conventional star network, individual nodes may thus still be isolated from the network by a single-point failure of a transmission path to the node. *Note 3:* A single-point failure of a transmission path within a distributed node will result in

partitioning two or more stations from the rest of the network.

null: 1. In an antenna radiation pattern, a zone in which the effective radiated power is at a minimum relative to the maximum effective radiated power of the main beam. *Note 1:* A null often has a narrow directivity angle compared to that of the main beam. Thus, the null is useful for several purposes, such as radio navigation and suppression of interfering signals in a given direction. *Note 2:* Because there is reciprocity between the transmitting and receiving characteristics of an antenna, there will be corresponding nulls for both the transmitting and receiving functions**. 2.** A dummy letter, letter symbol, or code group inserted in an encrypted message to delay or prevent its solution, or to complete encrypted groups for transmission or transmission security purposes. [NIS] **3**. In database management systems, a special value assigned to a row or a column indicating either unknown values or inapplicable usage. **4.** *Synonym* **node** (def. #4).



network topologies

Nyquist interval: The maximum time interval between equally spaced samples of a signal that will enable the signal waveform to be completely determined. The Nyquist interval is equal to the reciprocal of twice the highest frequency component of the sampled signal. In practice, when analog signals are sampled for the purpose of digital transmission or other processing, the sampling rate must be more frequent than that defined by Nyquist's theorem, because of quantization error introduced by the digitizing process. The required sampling rate is determined by the accuracy of the digitizing process.

Nyquist rate: The reciprocal of the Nyquist interval, *i.e.*, the minimum theoretical sampling rate that fully describes a given signal, i.e., enables its faithful reconstruction from the samples. *Note*: The actual sampling rate required to reconstruct the original signal will be somewhat higher than the Nyquist rate, because of quantization errors introduced by the sampling process.

Nyquist's theorem: A theorem, developed by H. Nyquist, which states that an analog signal waveform may be uniquely reconstructed, without error, from samples taken at equal time intervals. The sampling rate must be equal to, or greater than, twice the highest frequency component in the analog signal. *Synonym* **sampling theorem.**

orderwire: *See* **orderwire circuit.**

orderwire circuit: A voice or data circuit used by technical control and maintenance personnel for coordination and control actions relative to activation, deactivation, change, rerouting, reporting, and maintenance of communications systems and services. *Synonyms* **engineering channel, engineering orderwire, orderwire, service channel.**

packet: In data communication, a sequence of binary digits (arranged in a specific format), including data and control signals, that is transmitted and switched as a composite whole.

packet transfer mode: A method of information transfer, by means of packet transmission and packet switching, that permits dynamic sharing of network resources among many connections.

path: 1. In communications systems and network topologies, a route between any two points. **2.** In radio communications, the route that (a) lies between a transmitter and a receiver and (b) may consist of two or more concatenated links. *Note:* Examples of paths are line-of-sight paths and ionospheric paths. **3.** In a computer program, the logical sequence of instructions executed by a computer. **4.** In database management systems, a series of physical or logical connections between records or segments, usually requiring the use of pointers.

point-to-point link: A dedicated data link that connects only two stations.

point-to-point transmission: Communications between two designated stations only.

polar cap absorption: An intense radiowave absorption phenomenon in magnetic polar regions, and one of the most catastrophic events in connection with HF radio propagation in the high-latitude zone.

polling: 1. Network control in which the control station invites tributary stations to transmit in the sequence specified by the control station. **2.** In point-to-point or multipoint communication, the process whereby stations are invited one at a time to transmit. **3.** Sequential interrogation of devices for various purposes, such as avoiding contention, determining operational status,

or determining readiness to send or receive data. **4.** In automated HF radio systems, a technique for measuring and reporting channel quality.

pulse sounding: *See* **sounding.**

push-to-talk (PTT) operation: In telephone or two-way radio systems, that method of communication over a speech circuit in which the talker is required to keep a switch operated while talking. *Note*: In two-way radio, push-to-talk operation must be used when the same frequency is employed by both transmitters. For use in noisy environments, or for privacy, some telephone handsets have push-to-talk switches that allow the speaker to be heard only when the switch is activated. *Synonym* **press-to-talk operation.**

query call: In adaptive high-frequency (HF) radio, an automatic-link-establishment call that requests responses from stations having connectivity to the destination specified in the call.

queue: A set of items, such as telephone calls or packets, arranged in sequence. *Note*: Queues are used to store events occurring at random times and to service them according to a prescribed discipline that may be fixed or adaptive.

queue traffic: 1. A series of outgoing or incoming calls waiting for service. **2.** In a store-and-forward switching center, the outgoing messages awaiting transmission at the outgoing line position.

queuing: The process of entering elements into or removing elements from a queue.

queuing delay: 1. In a switched network, the time between the completion of signaling by the call originator and the arrival of a ringing signal at the call receiver. *Note*: Queues may be caused by delays at the originating switch, intermediate switches, or the call receiver servicing switch. **2.** In a data network, the sum of the delays between the request for service and the establishment of a circuit to the called data terminal equipment (DTE). **3.** In a packet-switched network, the sum of the delays encountered by a packet between the time of insertion into the network and the time of delivery to the addressee.

queuing theory: The theoretical study of waiting lines, expressed in mathematical terms--including components such as number of waiting lines, number of servers, average wait time, number of queues or lines, and probabilities of queue times' either increasing or decreasing. *Note:* Queuing theory is directly applicable to network telecommunications, server queuing, mainframe computer queuing of telecommunications terminals, and advanced telecommunications systems.

rake: A processing technique designed to compensate for multipath fading effects by “raking” together all multipath components that are encountered over a signal path. Raking belongs to a class of matched-filter techniques that may be used to dispose of selective fading. Appropriate modification of the concept (with adaptive equalization) permits elimination of intersymbol interference.

Rayleigh distribution: A mathematical statement, usually applied to frequency distributions of random variables, for the case in which two orthogonal variables are independent and normally distributed with unit variance.

Rayleigh fading: In electromagnetic wave propagation, phase-interference fading caused by multipath, and which may be approximated by the Rayleigh distribution.

real-time channel evaluation (RTCE): The process of measuring appropriate parameters from a set of communication channels in real time and using the data thus obtained to describe quantitatively the states of those channels and hence the capabilities for passing a given class, or classes, of communication traffic.

reception reliability: the probability that for a given circuit and for all transmitted frequencies a specified performance is achieved.

reflector: 1. In Yagi antenna systems, the element (behind the driven element) that is used to produce a unidirectional radiation pattern. **2.** A select e-mail mailing list that consists of e-mail addresses for a specific interest group. *Synonyms:* **e-mail exploder, mailing list, server.**

relay: 1. To retransmit a received message from one station to another station. **2.** An electromechanical or semiconductor switch (*i.e.*, solid-state relay) in which a current or voltage applied across one port or terminal controls electrical currents or voltages that appear across another terminal or terminals.

reliability: 1. The probability that a specified performance is achieved. **2.** The ability of an item to perform a required function under stated conditions for a specified period of time. **3.** The continuous availability of communication services to the general public, and emergency response activities in particular, during normal operating conditions and under emergency circumstances with minimal disruption. *See also*

- **basic mode reliability**
- **circuit reliability**
- **mode reliability**
- **reception reliability**
- **service reliability**

ROTHR: relocatable over-the-horizon radar.

route: 1. In communications systems operations, the geographical path that is followed by a call or message over the circuits that are used in establishing a chain of connections. **2.** To determine the path that a message or call is to take in a communications network. *Note*: In a Transmission Control Protocol/Internet Protocol (TCP/IP) internet, each IP datagram is routed separately. The route a datagram follows may include many gateways and many physical networks. **3.** To construct the path that a call or message is to take in a communications network in going from one station to another or from a source user end instrument to a destination user end instrument.

route diversity: The allocation of circuits between two points over more than one geographic or physical route with no geographic points in common.

route matrix: In communications network operations, a record that indicates the interconnections between pairs of nodes in the network, and is used to produce direct routes, alternate routes, and available route tables from point to point.

router: In data communications, a functional unit used to interconnect two or more networks. *Note 1:* Routers operate at the network layer (layer 3) of the ISO Open Systems Interconnection—Reference Model. *Note 2:* The router reads the network layer address of all packets transmitted by a network, and forwards only those addressed to another network.

RTCE: real-time channel evaluation.

RTTY: radio teletype.

scanning: 1. In telecommunications systems, examination of traffic activity to determine whether further processing is required. *Note:* Scanning is usually performed periodically. **2.** In television, facsimile, and picture transmission, the process of successively analyzing the colors and densities of the object according to a predetermined pattern. **3.** The process of tuning a device through a predetermined range of frequencies in prescribed increments and at prescribed times. *Note:* Scanning may be performed at regular or random increments and intervals. **4.** In radar and radio direction-finding, the slewing of an antenna or radiation pattern for the purpose of probing in a different direction. *Note 1:* In radar, scanning may be mechanical, using a rotary microwave joint to feed the antenna, or electronic, using a phased array of radiators, the radiated pattern (beam) of which depends on the relative phases of the signals fed to the individual radiators. *Note 2:* In civilian air traffic control radar, scanning usually implies continuous rotation of the antenna or beam about a vertical axis. In military radars, scanning may occur about other than a vertical axis, and may not encompass a full 360°.

service reliability: the probability that for a specified percentage of the service area and for all transmitted frequencies a specified performance will be achieved.

SID: sudden ionospheric disturbance.

signal-to-noise ratio (SNR): The ratio of the amplitude of the desired signal to the amplitude of noise signals at a given point in time. [Joint Pub. 1-02] SNR is expressed as 20 times the logarithm of the amplitude ratio, or 10 times the logarithm of the pour ratio. SNR is usually expressed in dB and in terms of peak values for impulse noise and root-mean-square values for random noise. In defining or specifying the SNR, both the signal and noise should be characterized, *e.g.*, peak-signal-to-peak noise ratio, in order to avoid ambiguity.

selcall: *Acronym for* **selective calling.** Calling from one station in which call identification is sent to signal automatically one or more remote stations and to establish links among them. *Note 1:* Selective calling may be used to un-mute the speakers at designated stations or to initiate a handshake for link establishment. *Note 2:* Selective calling is specified in CCIR Recommendations for HF and VHF/UHF radio, generally for ship-to-shore, ship-to-ship, aircraft-to-aircraft, and aircraft-to-ground communications.

selective calling: *See* **selcall**.

skywave: A radio wave that travels upward from the antenna. *Note:* A skywave may be reflected to Earth by the ionosphere.

SHF: 3 to 30 GHz, radio propagation frequencies used principally in troposcatter and LOS situations.

space diversity: A method of transmission or reception, or both, in which the effects of fading are minimized by the simultaneous use of two or more physically separated antennas, ideally separated by one or more wavelengths.

SNR: *Abbreviation for* **signal-to-noise ratio.**

sounding: 1. In automated HF radio systems, the broadcasting of a very brief signal, containing the station address, station identifier, or call sign, to permit receiving stations to measure link quality. **2** The ability to empirically test selected channels (and propagation paths) by providing a very brief, beacon-like, identifying broadcast which may be utilized by other stations to evaluate connectivity, propagation, and

availability; and to select known channels for possible later use for communications. The sounding signal is a unilateral, one-way transmission which is performed at periodic intervals on unoccupied channels. If used, the following sounding parameters must be consistently applied in an agreed-upon manner: frequency of use, length of time it can be used, and length of time to wait after a faulty attempt.

source quench: A congestion-control technique in which a computer experiencing data traffic congestion sends a message back to the source of the messages or packets causing the congestion, requesting that the source stop transmitting.

store-and-forward (S-F): Pertaining to communications systems in which messages are received at intermediate routing points and recorded *i.e.,* stored, and then transmitted, *i.e.,* forwarded, to the next routing point or to the ultimate recipient.

sudden frequency deviation: A quasi-global disturbance phenomenon that may influence long-haul HF systems and that occurs within minutes of the appearance of an X-ray flare on the Sun's surface.

SWF: short wave faces A quasi-global disturbance phenomenon that may influence long-haul HF systems and that usually occurs within minutes of the appearance of an X-ray flare on the solar surface.

synchronism: 1. The state of being synchronous. **2.** For repetitive events with the same, multiple, or submultiple repetition rates, a relationship among the events such that a significant instant of one event bears a fixed time relationship to a corresponding instant in another event. Synchronism is maintained when there is a fixed, *i.e.,* constant, phase relationship among the group of repetitive events. **3.** The simultaneous occurrence of two or more events at the same instant on the same coordinated time scale.

synchronization: 1. The attaining of synchronism. **2.** The obtaining of a desired fixed relationship among corresponding significant instants of two or more signals. **3.** A state of simultaneous occurrences of significant instants among two or more signals.

throughput: 1. The number of bits, characters, or blocks passing through a data communication system, or portion of that system. Throughput may vary greatly from its theoretical maximum. Throughput is expressed in data units per period of time; *e.g.,* in the DDN, as blocks per second. **2.** The maximum capacity of a communications channel or system. **3.** A measure of the amount of work performed by a system over a period of time, *e.g.,* the number of jobs per day.

traffic: 1. The information moved over a communication channel. **2.** A quantitative measurement of the total messages and their length, expressed in CCS or other units, during a specified period of time.

traffic analysis: 1. In a communications system, the analysis of traffic rates, volumes, densities, capacities, and patterns specifically for system performance improvement. [From Weik '89] **2.** [The] study of communications characteristics external to the text. [NIS] **3.** The analysis of the communications-electronic environment for use in the design, development, and operation of new communications systems. [From Weik '89]

traffic capacity: The maximum traffic per unit of time that a given telecommunications system, subsystem, or device can carry under specified conditions.

traffic engineering: The determination of the numbers and kinds of circuits and quantities of related terminating and switching equipment required to meet anticipated traffic loads throughout a communications system.

traffic-flow security: 1. The protection resulting from features, inherent in some cryptoequipment, that conceal the presence of valid messages on a communications circuit; normally achieved by causing the circuit to appear busy at all times. [After JP1] **2.** Measures used to conceal the presence of valid messages in an on-line cryptosystem or secure communications system. *Note:* Encryption of sending and receiving addresses and causing the circuit to appear busy at all times by sending dummy traffic are two methods of traffic-flow security. A more common method is to send a continuous encrypted signal, whether or not traffic is being transmitted.

traffic intensity: A measure of the average occupancy of a facility during a specified period of time, normally a busy hour, measured in traffic units (erlangs) and defined as the ratio of the time during which a facility is occupied (continuously or cumulatively) to the time this facility is available for occupancy. Note: A traffic intensity of one traffic unit (one erlang) means continuous occupancy of a facility during the time period under consideration, regardless of whether or not information is transmitted. *Synonym* **call intensity.**

traffic load: The total traffic carried by a trunk or trunk group during a specified time interval.

traffic monitor: In a communications network, a service feature that provides basic data on the amount and type of traffic handled by the network.

traffic overflow: 1. That condition wherein the traffic offered to a portion of a communication system exceeds its capacity and the excess may be blocked or may be provided with alternate routing. **2.** The excess traffic itself.

traffic unit: *Synonym* **erlang**.

transmit flow control: In data communications systems, control of the rate at which data are transmitted from a terminal so that the data can be received by another terminal. *Note 1:* Transmit flow control may occur between data terminal equipment (DTE) and a switching center, via data circuit-terminating equipment (DCE), or between two DTEs. The transmission rate may be controlled because of network or DTE requirements. *Note 2:* Transmit flow control can occur independently in the two directions of data transfer, thus permitting the transfer rates in one direction to be different from the transfer rates in the other.

UHF: ultra-high frequency (300-3000 MHz) used for line-of-sight propagation (SATCOM, broadcast, radar, navigation, and TV).

VHF: very high frequency (30-300 MHz), used for line-of-sight and Es scatter propagation. [Television and FM broadcast.]

VLF: very low frequency (3-30 kHz), used for waveguides and for groundwave propagation. [Navigation, standard frequency transmission, transmission of standard time signals.]

voiceband: *Synonym* **voice frequency.**

voice channel availability: The probability of finding a 2.5-kHz spectral window where the interference level, measured within contiguous 100-Hz intervals throughout the 2.5-kHz window, is always below a defined

threshold level. (This condition is not as highly correlated with congestion as might be supposed.) *[From Goodman, 1992, used with written permission.]*

voice frequency (VF): Pertaining to those frequencies within that part of the audio range that is used for the transmission of speech. In telephony, the usable voice-frequency band ranges from approximately 300 Hz to 3400 Hz. In telephony the bandwidth allocated for a single voice-frequency transmission channel is usually 4 kHz, including guard bands. *Synonym* **voiceband.**

white noise: Noise having a frequency spectrum that is continuous and uniform over a specified frequency band. White noise has equal power per hertz over the specified frequency band. *Synonym* **additive white gaussian noise.**

wideband: **1.** The property of any communications facility, equipment, channel, or system in which the range of frequencies used for transmission is greater than 0.1% of the midband frequency. "Wideband" has many meanings depending upon application. "Wideband" is often used to distinguish it from "narrowband," where both terms are subjectively defined relative to the implied context. **2.** In communications security systems, a bandwidth exceeding that of a nominal 4-kHz telephone channel. **3.** The property of a circuit that has a bandwidth wider than normal for the type of circuit, frequency of operation, or type of modulation. **4.** In telephony, the property of a circuit that has a bandwidth greater than 4 kHz. **5.** Pertaining to a signal that occupies a broad frequency spectrum. *Synonym* **broadband.**